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Dear Philippa,

Many thanks for your email of 18th August.

The LMS is naturally keen to assist the EPSRC deploy its resources as effectively as possible. It is all too aware of the pressures arising from reduction in funding. However special care is needed when placing the mathematical sciences in the broad context of research funding in science and engineering. On the one hand mathematics plays a central role in solving problems in all application domains; but its role is often hidden or disguised. On the other hand, it is important to appreciate the unity of the subject; advances in any subarea of the subject enrich the whole, and much work transcends any classification by subject area. These features distance the mathematics from its extensive impact, but they are the essence of the power of mathematics and intrinsic to its nature: mathematics proceeds by abstracting or modelling, so that developments for one purpose are easily transferred to others.

There are problems inherent in the areas identified in EPSRC work on the mathematics landscape, but even if there were not, it is simply not useful to think in terms of growing maintaining or constraining subject areas as a whole. The challenge is not to choose which areas should receive more focused support but within areas or preferably within the subject as a whole to give preference to those lines of research which currently are judged to be of greatest value. One element of this that the EPSRC has already acknowledged is the role of individuals whose exceptional vision, arising rarely and unpredictably, often tightly focused on a particular area, is the usual way that transformational progress takes place.

The challenge of recognizing and selecting areas where additional support will be fruitful applies as much to the area of Statistics and Applied Probability which you have classified as "to grow" as to the other areas currently under review. The EPSRC model for Shaping Capability needs to be interpreted appropriately for each subject, and in particular for mathematical sciences. In order that decisions taken are in the national interest, the EPSRC will need understanding at a finer level of detail than it has at the moment and therefore it will need more effective engagement with the subject community.

You ask us for additional input to inform your discussions. Time is much too short for us to gather independent evidence necessary to make balanced judgment. Nor do we have available

the evidence on which the EPSRC is making its decisions. Finally, we do not know the context in which our comments will be taken, or the process by which your conclusions will lead to action. The mechanism by which 'grow', 'maintain' or 'reduce' decisions are implemented and the timescale on which it happens will fundamentally influence whether or not the intended purpose is achieved. In this context of ignorance, we felt the most helpful way to formulate our input is to suggest a series of questions that need to be answered, in the full knowledge that you will already have answered some of them.

1. Evidence

Clearly it would help to know what information you have gathered so far and how you have analysed that information. In view of the international nature of the mathematical research effort, it is essential to ask what international comparisons you have used: for example have you considered the levels of funding of the components of the EPSRC portfolio in the US or in other competitor nations? How are you taking account of the funding of areas of the mathematical sciences by the ERC and other bodies? What use have you made of information stemming from the 2008 RAE? In what ways have the conclusions of the recent IRMS been integrated into your thinking? The subject areas of the IRMS are well designed to reflect the subject area but do not correspond well to the EPSRC landscape.

Recommendation 1: We suggest that the fifteen headings used for the IRMS are adopted for strategic considerations, since they not only better reflect the nature of the subject, and ease international comparisons, but also permit the evidence gathered for the IRMS to be used more effectively. (The headings are as follows: 1 Algebra, 2 Geometry and Topology, 3 Number theory, 4 Analysis, 5 Logic, Combinatorics, 6 Numerical Analysis, 7 Statistics, 8 Probability, 9 Mathematical Aspects of Operational Research 10 Mathematical Physics, 11 Non-linear dynamical systems and complexity, 12 Theoretical mechanics and material science, 13 Mathematics in biology and medicine 14 Industrial mathematics, 15 Financial mathematics)

2. Connections.

In the light of your view of Importance, we would like to understand the basis for the connections between areas in your landscape diagram. Starting within the general area of Mathematical Sciences, based on collaborations and publications, connections at least as strong as most of those given - for example between Statistics and Applied Probability and AGTN and between Logic and Combinatorics and Mathematical Analysis - do not appear in your diagram.

Recommendation 2a: A new diagram should be formed using the above fifteen headings, and on it the connections based on international collaboration and publication should be recorded, along with an indication of relative strengths.

Moving on to connections outside the Mathematics Programme, what is your understanding of the connections between mathematics and other parts of the EPSRC science base? Amongst EPSRC identified research areas we would point to AI Technologies, Bioinformatics, Built Environment, Control Engineering, Fluid dynamics and aerodynamics, Graphics, ICT Networks and distributed systems, Mathematics of Computing, Natural Language Processing, Programming Languages and Compilers and finally Theory of Computation as having major dependencies on areas of the Mathematical Sciences. The whole of the mathematics portfolio is involved in one or other of these.

Recommendation 2b: A new diagram should be formed with nodes representing the main parts of the EPSRC science base, and on it should be marked the connections based on both underpinning and collaboration, along with an indication of relative strengths.

3. Impact
How is the process of Shaping Capability as it relates to these areas going to affect your picture of mathematics? Mathematical Sciences appears as one of the EPSRC themes: is the impact of a rich mathematical culture on other themes appreciated? Because of the pervasive and holographic nature of mathematical influence, neither the extent of it nor the importance of maintaining it as a living and responsive resource should be overlooked. Moving on to Importance in the sense of influence on the current and future economy and society, we are anxious that your model should reflect aspects such as national security, which are not only easily missed but actively disguised.

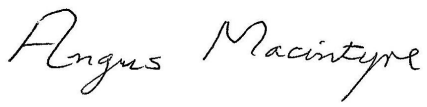
Recommendation 3: The effect of proposed Shaping decisions on the major existing or anticipated routes to Importance and Impact should be systematically assessed.

4. Expert input.
Finally you talk of ongoing discussions about the relative quality, importance and current and future capacity needs of different parts of the mathematical sciences. What is being done to ensure that such discussions are informed by wide and detailed knowledge of the subject at both national and international levels? The SAT is valuable, but was not selected for such an all-encompassing task, and is too small a group to have the range and focus necessary without assistance. The IRMS stressed the special importance of communication in the current difficult funding environment. This is a high priority if the EPSRC is to have the detailed understanding of subject areas and the direct knowledge of outstanding individuals which it will need for it to influence funding decisions in a constructive way. The snapshot of the IRMS evidence is a valuable starting point, but science and mathematics can develop swiftly, and the only way to be placed to take advantage of opportunities is to have an active and continuing connection to experts actively involved in research.

Recommendation 4: A panel including expertise across the breadth of mathematics should have continuing and direct involvement in the process of shaping. You might invite the writers of the Landscape Documents for the IRMS, already conveniently arranged into appropriate subareas, to gather a small team of 2 or 3 people. Each such small team could be commissioned to distil and update their Landscape Document to obtain a summary of current areas of strength and weakness in their field in the UK, and which lines of research in their areas "are currently judged to be of greatest value".

We are anxious to help the EPSRC in its mission. Whatever direction that takes, it is best served by a vigorous, creative and outward looking mathematical community. To that end we look forward to hearing from you in connection with the questions we have raised.

Yours sincerely



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